

CLAIMS

- 1 1. A heat pump system comprising: a heat generator; a heat engine supplied  
2 with heat engine working fluid by said heat generator having a heat engine  
3 cylinder chamber, a heat engine piston, and a heat engine piston rod; a  
4 preheating chamber employing said heat engine working fluid to heat said  
5 heat engine cylinder chamber; a condensate pump supplying said heat  
6 generator with said heat engine working fluid; a compressor driven by said  
7 heat engine employing compressor working fluid having a compressor  
8 cylinder chamber, a compressor piston, and a compressor piston rod; a  
9 spacer separating and joining said heat engine piston rod and said  
10 compressor piston rod; a sealing assembly associated with said spacer  
11 separating said heat engine working fluid and said compressor working  
12 fluid; and a valve assembly communicating with said heat engine cylinder  
13 chamber and controlling the ingress and egress of heat engine working  
14 fluid to said heat engine.
- 1 2. A heat pump system according to claim 1 further comprising, a turbo  
2 booster for improving the efficiency of the heat engine.
- 1 3. A heat pump system according to claim 2, wherein said turbo booster is  
2 powered by heat engine exhaust and operates to reduce back pressure on  
3 said heat engine piston.
- 1 4. A heat pump system according to claim 1, wherein said preheating  
2 chamber is an annular chamber surrounding said heat engine cylinder  
3 chamber.
- 1 5. A heat pump system according to claim 1, wherein said sealing assembly  
2 includes a pair of rolling diaphragms with a pressurized fluid interposed  
3 therebetween.

- 1 6. A heat pump system according to claim 5, wherein said pressurized fluid  
2 is water.
- 1 7. A heat pump system according to claim 1, wherein said heat engine  
2 cylinder chamber and said compressor cylinder chamber are constructed  
3 of a ceramic material.
- 1 8. A heat pump system according to claim 1, wherein said condensate pump  
2 transfers said heat engine working fluid from a condenser to said heat  
3 generator.
- 1 9. A heat pump system according to claim 8, wherein said condensate pump  
2 has a housing with a cylindrical cavity for receiving a pump piston  
3 attached via a driven shaft to said heat engine piston, and input and  
4 output lines communicating with a pumping chamber formed in a lower  
5 portion of said cylindrical cavity.
- 1 10. A heat pump system according to claim 9, wherein said condensate pump  
2 is driven by said heat engine inducing said pump piston to reciprocate  
3 within said cylindrical cavity and transfer said heat engine working fluid  
4 between said condenser and said heat generator via said pumping  
5 chamber.
- 1 11. A heat pump system according to claim 8, wherein said condensate pump  
2 has a cooling chamber, and a cooling fluid is draw into and of out said  
3 cooling chamber as said pump piston reciprocates within said cylindrical  
4 cavity.

- 1 12. A heat pump system according to claim 11, wherein said cooling chamber  
2 is formed by an upper portion of said cylindrical cavity, said driven shaft,  
3 an upper surface of said pump piston, and a ceramic seal provided in said  
4 upper portion of said cylindrical cavity and sized to sealingly interface with  
5 said driven shaft.
- 1 13. A heat pump system according to claim 1 further comprising, a heat  
2 exchanger for receiving heat from said heat pump system.
- 1 14. A heat pump system according to claim 13, wherein said heat exchanger  
2 receives said compressor working fluid.
- 1 15. A heat pump system according to claim 13, wherein said heat exchanger  
2 is a triple-tube heat exchanger receiving said compressor working fluid,  
3 said heat engine working fluid, and a fluid to be heated.
- 1 16. A heat pump system according to claim 15, wherein said fluid to be heated  
2 is selectively water from at least one of a water heater and a swimming  
3 pool.
- 1 17. A heat pump system comprising, a heat generator for heating a working  
2 fluid, a heat engine having a housing, a cylinder wall within said housing,  
3 a preheating chamber between said housing and said cylinder wall, and a  
4 line interconnecting said heat generator and said preheating chamber,  
5 whereby working fluid supplied to said preheating chamber by said heat  
6 generator heats said cylinder wall prior to the commencement of operation  
7 of said heat engine.
- 1 18. A heat pump system according to claim 17, wherein said preheating  
2 chamber is an annular space between said housing and said cylinder wall.

- 1 19. A heat pump system according to claim 17, wherein said cylinder wall  
2 houses a piston and is made of a heat conducting ceramic material,  
3 whereby heat in said cylinder wall is transmitted to said piston.
- 1 20. A heat pump system according to claim 17, wherein said housing is higher  
2 than said heat generator, whereby any condensate formed by said working  
3 fluid in said preheating chamber is returned to said heating chamber by  
4 said line.
- 1 21. A heat pump system comprising: a heat engine operating on a heat engine  
2 working fluid and having a heat engine cylinder chamber, a heat engine  
3 piston, and a heat engine piston rod; a compressor operating on a  
4 compressor working fluid and having a compressor cylinder chamber, a  
5 compression piston, and a compressor piston rod; a spacer separating and  
6 joining said heat engine piston rod and said compressor piston rod; and  
7 a sealing assembly maintaining separation of said heat engine working  
8 fluid and said compressor working fluid.
- 1 22. A heat pump system according to claim 21, wherein said sealing assembly  
2 includes a pair of rolling diaphragms with a pressurized fluid interposed  
3 therebetween.
- 1 23. A heat pump system according to claim 22, wherein said pressurized fluid  
2 is selected to resist the migration of components of said working fluids  
3 therebetween.
- 1 24. A heat pump system according to claim 22, wherein said pressurized fluid  
2 is water.

1 25. A heat pump system according to claim 22, wherein said rolling  
2 diaphragms have beads spaced by an annular insert having a fill tube for  
3 controlling the presence and pressure of said pressurized fluid.

1 26. A heat pump system comprising, a heat engine having a heat engine  
2 cylinder chamber and a heat engine piston movable therein, a turbo  
3 booster powered by exhaust from the high pressure side of said heat  
4 engine piston, a vacuum tank evacuated by said turbo booster, an engine  
5 condenser, and a flow control valve connecting the low pressure side of  
6 said heat engine piston to said vacuum tank during the power stroke of  
7 said heat engine piston and connecting the low pressure side of said heat  
8 engine to said condenser during the exhaust stroke of said heat engine  
9 piston, whereby back pressure on said heat engine piston is reduced during  
10 the power stroke thereof and equalized during the exhaust stroke thereof.

1 27. A heat pump system according to claim 26, wherein said turbo booster  
2 includes a turbine wheel actuated by exhaust from the high pressure side  
3 of said heat engine piston.

1 28. A heat pump system according to claim 27, wherein said turbo booster  
2 includes a pump driven by said turbine wheel, said pump having an input  
3 line connected to said vacuum tank and an output line connected to said  
4 engine condenser, whereby a reduced pressure is maintained in said  
5 vacuum tank.

1 29. A heat pump system according to claim 26, wherein said flow control valve  
2 is actuated by a valve assembly controlling the ingress and egress of  
3 working fluid to said heat engine cylinder chamber.

- 1 30. A condensate pump comprising: a housing with a cylindrical cavity; a  
2 pump piston received within said cylindrical cavity; a driven shaft attached  
3 to said pump piston; input and output lines communicating with a  
4 pumping chamber formed in a lower portion of said cylindrical cavity; and  
5 a cooling chamber formed by an upper portion of said cylindrical cavity,  
6 said driven shaft, an upper surface of said pump piston, and a ceramic seal  
7 provided in said upper portion of said cylindrical cavity and sized to  
8 sealingly interface with said driven shaft.
- 1 31. A condensate pump according to 30, wherein said pump piston  
2 reciprocates within said cylindrical cavity thereby transferring a working  
3 fluid from a condenser through said pumping chamber to a heat generator.
- 1 32. A condensate pump according to 30, wherein a cooling fluid is drawn into  
2 and out of said cooling chamber as said pump piston reciprocates within  
3 said cylindrical cavity.
- 1 33. A heat pump system comprising: a heat generator; a heat engine having  
2 a heat engine piston rod supplied with heat engine working fluid by said  
3 heat generator; a compressor having a compressor piston rod driven by  
4 said heat engine employing compressor working fluid; a spacer separating  
5 and joining said heat engine piston rod and said compressor piston rod;  
6 a sealing assembly associated with said spacer separating said heat engine  
7 working fluid and said compressor working fluid; a heat exchanger  
8 connected to a fluid reservoir whereby said heat engine working fluid and  
9 said compressor working fluid are directed to said heat exchanger.
- 1 34. A heat pump system according to claim 33, wherein said fluid reservoir is  
2 selectively at least one of a water heater and a swimming pool, and said  
3 heat exchanger is a triple-tube heat exchanger receiving said heat engine

- 1 working fluid, said compressor working fluid, and a fluid from said fluid
- 2 reservoir.